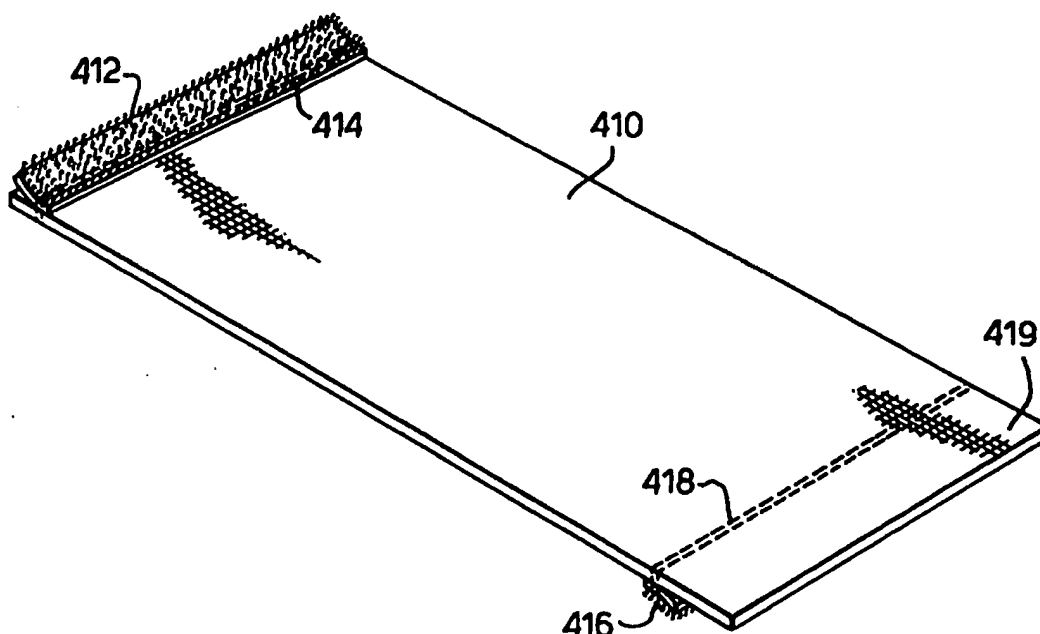




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(54) Title: WRAPAROUND HEAT-SHRINKABLE ARTICLE



(57) Abstract

Wraparound shrinkable (preferably fabric) sleeve (410) closable around a substrate by means of Velcro® strips (412, 416) attached (preferably stitched) to sleeve only at the edge (414, 418) of the Velcro® facing towards other end of sleeve. The edge stitching reduces tendency to peel open under shrinkage forces after sleeve is conveniently secured around a substrate by overlapping engagement of the Velcro® strips.

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WRAPAROUND HEAT-SHRINKABLE ARTICLE

This invention relates to a wraparound heat-shrinkable article, preferably a fabric article, which may be useful *inter alia* in the feedthrough assemblies, kits, and methods described in our co-pending British Patent Applications No. 9603629.8 (RK552 GB1), No. 9606393.8 (GB2), No.9611111.7 (GB3), and No.9613580.1 (GB4), and the corresponding International Application No. PCT/GB97/00476.

Heat-shrinkable articles are generally known, either in extruded or moulded plastics form, or in fabric form as hereinafter described, but the present invention relates to a uniquely convenient and effective closure for securing such articles when wrapped around a substrate ready for shrinking to grip the substrate.

The invention accordingly provides a heat-shrinkable (preferably fabric) article capable of being wrapped around an object about which the article is to be heat shrunk, the respective end regions of the article having fastening means capable of fastening the wrapped article around the object before and during heat shrinking of the article, wherein the fastening means of at least a first one of the end regions comprises a fastening strip extending transversely to the shrinkage direction of the article, which fastening strip is attached to the fabric article substantially only along one edge of the strip which lies nearer to the other end region of the article.

The precise shape of the fastening strip is not critical to the invention. The strip may be composed of a number of separate pieces and/or may be of curved or irregular shape, but a single substantially straight-edged strip extending substantially all the way across the shrinkable article will generally be preferred. It will be understood that the fastening of the strip "along one edge" means that the fastening is effected along the edge region of the strip, not necessarily exactly at its edge.

A great advantage of the specified edge attachment of the fastening strip to the shrinkable (preferably fabric) article is that, when the said first end region having the said

fastening strip is capable of being wrapped and fastened outside and overlapping the other end region of the article, the subsequent heat shrinkage forces will be less likely to peel open the overlapping fastening than would be the case if the whole surface of the fastening strip were attached to the shrinkable article. In the present case, the shrinkage forces will act on the fastening strip only through its attached leading edge ("leading" in the direction of the shrinkage "pull" on the strip), resulting in less peeling leverage than may be the case when the shrinkage forces act over the whole strip surface including its trailing edge. This effectively "hinged" attachment of the fastening strip to the shrinkable article may help to alleviate the problems of bond failure which are well known to occur when adhesive overlap bonds are used to fasten wrap-around sleeves.

Although the said fastening strip attached to one end region of the heat-shrinkable (preferably fabric) article could interact with formations integral with the other end region of the article in order to fasten it in wrapped-around arrangement, it will usually be preferred that the fastening means of the other end region of the article comprises a second fastening strip extending transversely to the shrinkage direction of the article and capable of engaging with the strip of the said first one of the end regions. In this case, the said second strip is preferably also attached to the shrinkable article along one edge of the strip which lies nearer to the said first end region, so that both fastening strips will be pulled by their leading edges in the direction of fabric recovery thus reducing the risk of opening of the fastened wraparound article during shrinkage.

Any form of fastening strip capable of interacting with the fastening means at the other end of the shrinkable article to secure the wrapped-around article in use may be used for the present purposes, but it is preferred that the fastening strip of the said first end region and the fastening means of the other end region together comprise a "touch-to-close" fastener, preferably of the type well known under the Trade Mark "VELCRO", or similar thereto.

Preferably, the fastening strip(s) is(are) attached to a fabric heat-shrinkable article by sewing along the said edge of the strip(s). Other forms of attachment, for example

stapling or bonding with high strength (preferably curable) adhesives may also be useable, and may be preferable on non-fabric articles, but sewing is generally preferable, being well suited to use on fabric articles. The specified edge attachment of the fastening strip(s) may be applicable to heat-shrinkable articles made of plastics film, especially when non-penetrative attachment techniques such as the aforementioned high strength adhesives are used. However, penetrative attachment such as the preferred sewing may cause such film articles to tear during shrinkage, whereas it is a unique advantage of heat-shrinkable fabric articles that they can be highly resistant to such tearing or splitting during shrinkage.

It is preferred for the present purposes that the heat-shrinkable fabric article have a polymeric sheet laminated to one of its main surfaces, for example a sheet of low density polyethylene. The heat-shrinkable fabric article preferably carries a heat-activatable (preferably induction-heatable) sealant layer on one of its main surfaces, preferably the surface which does not have the aforementioned polymeric sheet laminate which is preferably present. Heat-shrinkable fabric articles of this general kind are nowadays well known from a number of commercially available products supplied by Raychem, and from a number of Raychem patents, for example EP-A-0278707 (B137), EP-A-0117026 (RK176), EP-A-0115905 (RK177), and EP-A-0324630 (RK357), the disclosures of all of which are incorporated herein by reference. Suitable structures and techniques for making the fabric articles for the present purposes may readily be selected by persons familiar with such technology. As an alternative to coating the heat-activatable sealant on the fabric article, a separate layer of such sealant could be applied to the object about which the fabric article is to be shrunk in use, followed by wrapping and shrinking of the fabric article resulting in consolidation of the sealant and the fabric.

This new form of heat-shrinkable article (hereinafter referred to for brevity in terms of the preferred fabric) with the edge-attached fastening strip(s) is regarded and claimed as an invention in its own right, and may be used any convenient way, for example in an assembly, kit, or method as described in or according to any claim of the aforementioned co-pending British Patent Applications number 9603629.8, 9606393.8, or

961111.7. It is an advantage of the induction heating preferably used to block the wiring bundles in the wall or bulkhead feedthroughs to which those applications refer, that the fastening means (eg. "VELCRO" strips) is less affected by the heat generated inside the adhesive and wires enclosed by the wrapped fabric article than would be the case if the wrapped article were shrunk by external application of heat, for example using known flame or hot air guns. The fastening means is thus more likely to survive the shrinkage in a state to retain the wrapped article in place when the induction heating is used.

When a blocking sealant or adhesive is used to fill interstices within the wiring bundle enclosed by the shrinking fabric article, the fastening means need only act as a securing process aid until such time as the blocking adhesive has flowed and solidified to hold the wrapped fabric article in place. However, a re-openable fastening such as the preferred "VELCRO" closure may advantageously facilitate re-opening of the wrapped heat-shrunk article by providing a clear starting point for convenient gripping to unwrap the article after heating to re-soften the blocking adhesive.

Specific embodiments of the various aspects hereinbefore referred to will now be described with reference to the accompanying drawings wherein :-

Figure 1 shows schematically in perspective a heat-shrinkable fabric article having the aforementioned edge-attached fastening means;

Figure 2 shows schematically in edge view the article of Figure 1 wrapped around and fastened by the said fastening means;

Figure 3 shows schematically in a more detailed edge view the structure of the article shown in Figure 1; and

Figure 4 shows schematically in partial section the article wrapped as shown in Figure 2 around a unitary collar-and-plate bulkhead feedthrough assembly with a wiring bundle extending therethrough, prior to shrinking of the fabric sleeve.

Referring to Figure 1, a known heat-shrinkable fabric 10 having heat-shrinkable filaments extending in its longitudinal direction as illustrated has one part of a "VELCRO" touch-to-close fastener 12 attached near one end of the fabric by lines of

stitching 14 along that edge of the fastener part which is closest to the other end of the fabric article. The complimentary part of the "VELCRO" fastener 16 is attached to the other end region of the article by stitching 18. This part 16 of the fastener is spaced from the adjacent end of the fabric article to leave a tail 19 for purposes described hereinafter.

In Figure 2, the fabric article 10 is shown wrapped around and fastened together by the fastener strips 12, 16 so as to leave the free end tail 19 on the inside of the wrapped enclosure. On heat shrinking of the fabric, shrinkage forces are generated in the direction of the two arrows in Figure 2, but these forces pull respectively on the attached leading edge only of the fastener parts 12, 16, thus tending not to pull apart the remote unsewn edges of the respective fastener parts. The tail 19 serves to bridge the overlap "step" between the outer and inner layers of the fabric article, thus facilitating sealing of the wrapped enclosure for cable-blocking purposes.

Figure 3 shows in more detail a preferred structure of the fabric article 10, comprising a central layer of woven fabric 20 having a laminate of low-density polyethylene 22 on the surface of the fabric which will face outwards in use, and a coating of the aforementioned inductively-heatable blocking adhesive 24 on the surface of the fabric which will face inwards in use. The fastener parts 12, 16 are sewn onto this laminated structure as described above. In this and all forms of the sleeves, it may be preferred to use fastener strips of a colour which contrasts with that of the sleeve itself, thus facilitating operator accuracy in joining the fasteners together under production-line conditions, e.g. for automotive harness assembly.

As shown schematically in Figure 4, the fabric article 10 has been fastened together around the projecting collar boss 30 permanently attached to plate-like member 32 of an automotive bulkhead feedthrough assembly as generally described in the aforementioned co-pending application No.9606393.8. The sleeve has a shrinkage ratio of approximately 3:1 in the circumferential direction around the collar boss 30, through which a wiring bundle or harness 40 is shown projecting. Blocking adhesive tape (not shown) is inserted in schematically-indicated apertures 42 between sub-bundles of wires

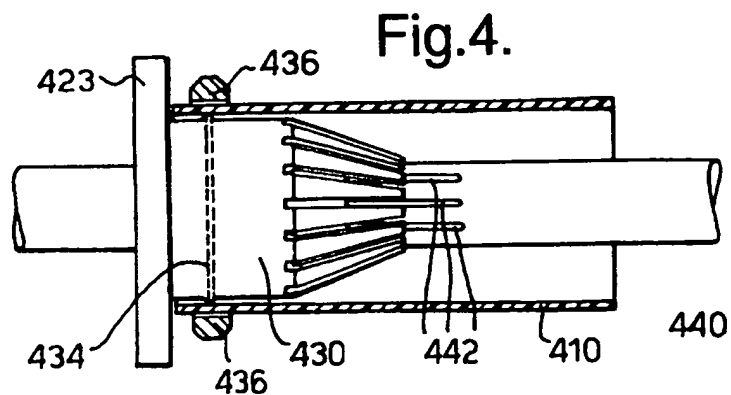
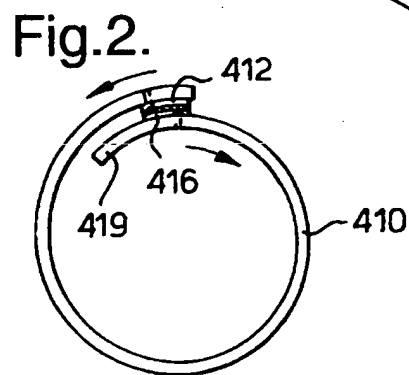
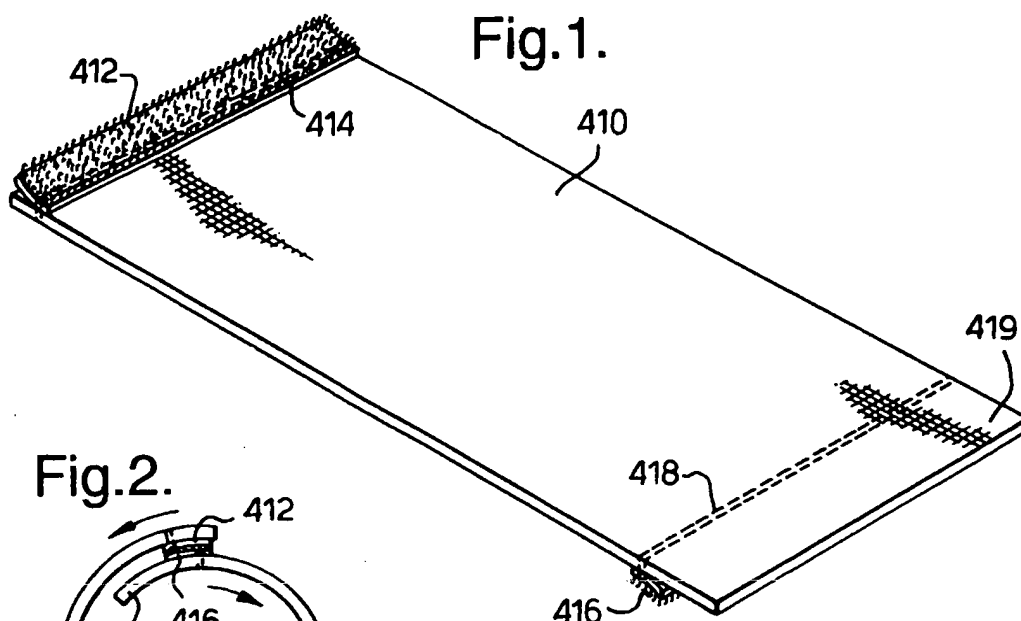
formed within the bundle 40 for the purpose of forming a block in region of the bundle between the parallel broken lines. This blocking adhesive within the wiring bundle, together with the adhesive layer 24 on the inner surface of the wrapped sleeve 10, will subsequently be inductively heated to shrink the sleeve 10 and block all interstices within the resulting tightly shrunk enclosure around the bundle 40 and within the bundle itself. The projecting collar boss 30 may have a ridge or other formation to resist "milk-off" of the sleeve during shrinking thereof, as indicated by broken lines 34, but it may be preferred, for simplicity, to omit such ridges and use temporary clamps or ties 36 to hold the sleeve in place on the collar boss 30 until shrinkage is complete.

CLAIMS:

1. A heat-shrinkable (preferably fabric) article capable of being wrapped around an object about which the article is to be heat shrunk in use, the respective end regions of the article having fastening means capable of fastening the wrapped article around the object before and during heat shrinking of the article, wherein the fastening means of at least a first one of the end regions comprises a fastening strip extending transversely to the shrinkage direction of the article, which fastening strip is attached to the fabric article along one edge of the strip which is nearer to the other end region of the article.
2. An article according to claim 1, wherein the said first end region having the said fastening strip is capable of being wrapped and fastened outside the other end region of the article.
3. An article according to claim 1 or claim 2, wherein the fastening means of the other end region of the article comprises a second fastening strip extending transversely to the shrinkage direction of the article and capable of engaging with the strip of the said first one of the end regions.
4. An article according to claim 3, wherein the said second strip is attached to the shrinkable article along one edge of the strip which lies nearer to the said first end region.
5. An article according to any preceding claim, wherein the fastening strip of the said first end region and the fastening means of the other end region together constitute a touch-to-close fastener, preferably "Velcro" (Trade Mark) or similar.
6. An article according to any preceding claim, wherein the fastening strip(s) is (are) attached to the shrinkable article by sewing along the said edge of the strip(s).
7. A fabric article according to any preceding claim, having a polymeric sheet laminated to one of its main surfaces.

8. An article according to claim 7, having a heat-activatable (preferably induction-heatable) sealant layer on the other of its main surfaces.

9. An assembly, kit or method according to any claim of British Patent Application No.9603629.8 (RK552 GB1), No.9606393.8 (GB2), No.9611111.7 (GB3), or No.9613580.1 (GB4), wherein the said sleeve comprises an article according to any of the preceding claims 1 to 8 of the present application.



INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 97/00475

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B29C61/10 B29C65/56 B29C53/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B29C H02G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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